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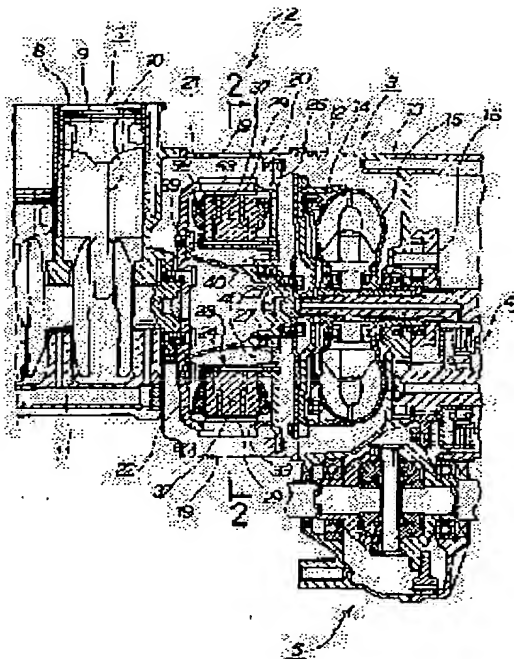
(72)Inventor : MASUI RITSUO

## (54) COOLING CONSTRUCTION FOR MOTOR

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To efficiently cool a stator and a rotor by providing an air inlet and an air outlet in a motor housing and opening air passages from the center of rotation to radial direction of the motor for the stator and rotor housed in the motor housing.

**SOLUTION:** A generator-motor 2 comprises a motor housing 20 equipped with air outlets 19... (... means plurality), a cup type rotor 22, a stator 24, a housing cover 26 and a bearing 27. The rotor 22 is equipped with a predetermined number of magnets 29... on the internal peripheral surface and a plurality of air passages 33... penetrating between the inside and the outside. Also, the housing cover 26 is equipped with air inlets 40... in the central portion. Then, the rotor 22 begins to rotate together with a crank shaft 11, outside air enters into the air inlets 40... through an air inlet 12 at the side of housing 3, and this air passes through air passages 33... from air passages 53... at the side of stator 24 and moves to outside from the air outlets 19 at the side of a housing main body 21. By doing this, forced air cooling becomes possible.



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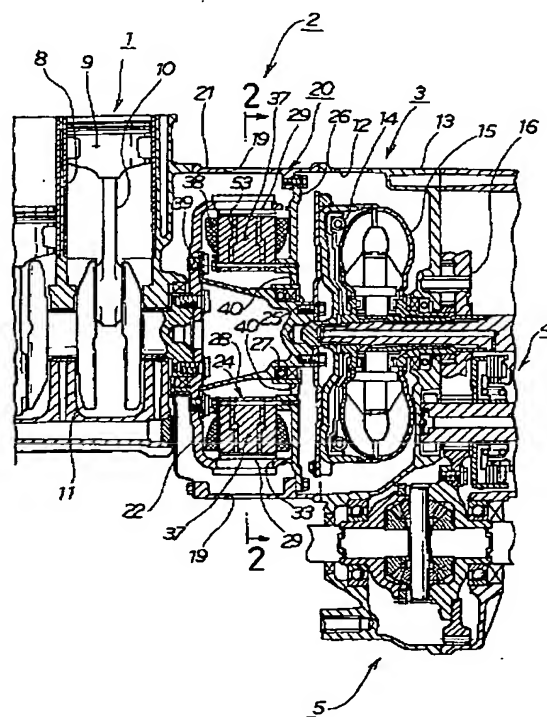
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(54)【発明の名称】電動機の冷却構造

(57)【要約】

【解決手段】 電動機の冷却構造において、モータハウジング20に空気吸入口40と空気排出口19とを設け、モータハウジング21に収納したステータ24及びロータ22にモータの回転中心から径外方へ向う空気通路53, 33を開けた。

【効果】 ステータ及びロータに空気を通し直接冷却することができ、特に発熱源であるステータのコイル鉄心内部の冷却ができる。また、ロータの回転数が上がると空気通路に流入する空気の量も増加し、冷却効果が大きくなるため、冷却能力が向上する。



## 【特許請求の範囲】

【請求項 1】 モータハウジングに空気吸入口と空気排出口とを設け、モータハウジングに収納したステータ及びロータにモータの回転中心から径外方へ向う空気通路を開けたことを特徴とする電動機の冷却構造。

【請求項 2】 モータハウジングに空気吸入口と空気排出口とを設け、モータハウジングにロータを収納し、このロータ内側にステータを収納し、これらステータ及びロータにモータの回転中心から径外方へ向う空気通路を開けたことを特徴とする電動機の冷却構造。

【請求項 3】 前記ステータのコイル鉄心を複数枚の積層板で構成し、切欠き溝のある鋼板と切欠き溝のない鋼板とを適宜組み合わせ積層することでステータの空気通路を形成したことを特徴とする請求項 1 又は請求項 2 記載の電動機の冷却構造。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は電動機の冷却構造の改良技術に関する。

## 【0002】

【従来の技術】 電動機はモータハウジングにロータならびにステータを収納し、電流を流してロータを回転するため、その構造上必然的にジュール熱が発生し、このジュール熱を適宜逃がしてやる必要がある。その技術として、例えば特開平 4-317542 号公報「車両の制動および補助駆動装置用誘導機の冷却装置」が知られている。この技術は、同公報の図 1 によれば、誘導機 2 をハウジング 3 2、6 4 に収納し、これらのハウジング 3 2、6 4 にオイルを供給し、このオイルで誘導機 2 の発熱を吸収するという油冷式構造である。

## 【0003】

【発明が解決しようとする課題】 上記の油冷式では冷媒通路、シール部品、循環ポンプ、放熱器等部品点数も多く複雑であり、コスト的にも高価なものであった。一方、外置きファンでモータハウジングを冷却する空冷式構造が一般に採用されているが、この方式では、モータハウジングは冷却されるが、その内部のロータならびにステータは縁が切れてるため冷却されにくい。また、これらロータならびにステータは一定の狭い隙間を保って支持され、このステータに巻かれたコイル表面は防水対策やコイル巻線保持のため、樹脂またはワニス等にて固着しているのが通常あり、これが放熱効果を妨げる原因でもあった。

【0004】 そこで、本発明の目的は、ステータ及びロータを効果的に冷却することができる電動機の冷却構造を提供することにある。

## 【0005】

【課題を解決するための手段】 上記目的を達成するために請求項 1 は、モータハウジングに空気吸入口と空気排出口とを設け、モータハウジングに収納したステータ及

びロータにモータの回転中心から径外方へ向う空気通路を開けたことを特徴とする。ステータ及びロータに空気を通し直接冷却することができ、特に発熱源であるステータのコイル鉄心内部の冷却ができる。ロータの回転数が上がると空気通路に流入する空気の量も増加し、冷却効果が大きくなるため、冷却能力が向上する。

【0006】 請求項 2 は、モータハウジングに空気吸入口と空気排出口とを設け、モータハウジングにロータを収納し、このロータ内側にステータを収納し、これらステータ及びロータにモータの回転中心から径外方へ向う空気通路を開けたことを特徴とする。ステータ及びロータに空気を通し直接冷却することができ、特に発熱源であるステータのコイル鉄心内部の冷却ができる。ロータの回転数が上がると空気通路に流入する空気の量も増加し、冷却効果が大きくなるため、冷却能力が向上する。ステータに対しロータを外周に設けたので、遠心力が大きく、空気通路に流入する空気の量も多くできるのでさらに冷却効果が高い。

【0007】 請求項 3 は、ステータのコイル鉄心を複数枚の積層板で構成し、切欠き溝のある鋼板と切欠き溝のない鋼板とを適宜組み合わせ積層することでステータの空気通路を形成したことを特徴とする。ステータのコイル鉄心を複数枚の積層板で構成し、切欠き溝のある鋼板と切欠き溝のない鋼板とを適宜組み合わせ積層することでステータの空気通路を形成したので、組み合わせ枚数により通路面積を変えることができる。別部品を使用することなく空気通路を形成できるので、安価である。

## 【0008】

【発明の実施の形態】 本発明の実施の形態を添付図に基づいて以下に説明する。なお、図面は符号の向きに見るものとする。図 1 は本発明に係るハイブリッド車駆動系装置の要部断面図である。ハイブリッド車駆動系装置は、エンジン 1 と発電電動機 2 とミッション 3 とクラッチ 4 とデフ 5 とからなる。前記エンジン 1 はシリンダー 8 とピストン 9 とコンロッド 10 とクランクシャフト 11 とを備える。ミッション 3 は、空気吸入口 12 を備えるミッションハウジング 13 と、ロックアップ・クラッチ 14 を備えるトルクコンバーター 15 と、自動変速機 16 とからなる。

【0009】 発電電動機 2 は、空気排出口 19…（…は複数を示す。以下同じ）を備えるモータハウジング 20 とカップ形のロータ 22 と、このロータ 22 の内部に同心的に収納したステータ 24 と、このステータ 24 を固定する軸受 25 を含むハウジングカバー 26 と、ベアリング 27 とからなる。なお、モータハウジング 20 はハウジング本体 21 と、ハウジングカバー 26 からなる。

【0010】 図 2 は図 1 の 2-2 線部分断面図であり、ロータ 22 は内周面に所定数のマグネット 29…と、内外を貫通する複数の空気通路 33…と、これら空気通路

33…の出口側に複数のガイド片34…とを備える。28はロータ22の軸部材である。ステータ24は複数の積層板(詳細後述)で構成した鉄心37…と、この鉄心37…に巻いたコイル38…と、これらを前記ハウジングカバー26に取付けるためのボルト39…とからなる。また、ハウジングカバー26は中央部に空気吸入口40…を備え、前記ハウジング本体21に固定される。

【0011】図3は本発明に係る積層板の形状及び組立要領を示す図である。積層板35aはボルト穴42と、コイル巻線部43とを備えた「切欠き溝のない板」である。積層板35bはボルト穴42と、コイル巻線部43と、このコイル巻線部43中央から上方向へ向うU字切欠き溝44とを備えた「切欠き溝のある板」である。積層板35cはコイル巻線部43と、このコイル巻線部43中央から斜め下方向へ向う略U字切欠き溝45とを備え、この略U字切欠き溝45に前記ボルト穴42よりさらに大径のボルト貫通用丸部48を備えた「切欠き溝のある板」である。

【0012】図4(a)～(b)は本発明に係る積層板の組立図である。(a)は積層板35a～35cの組立後の正面図で、破線は形成された空気通路53…を示す。なお、前述の如く前記ボルト穴42より積層板35c…のボルト貫通用丸部48はさらに大径なので、ボルト39を通して空気通路53…をふさぐことはない。

(b)は積層板35a…、35b…、35c…、35a…をそれぞれ2枚ずつ組立後の4b-4b線断面を示す。矢印①、②、③は形成された空気通路53…を通る空気の流れを示す。

【0013】以上に述べた電動機の冷却構造の作用を次に説明する。図5は本発明に係る電動機の冷却構造の作用説明図である。クランクシャフト11が回転すると、このクランクシャフト11と共にロータ22が回転し始める。このロータ22は図2に示す通りファンの形状を呈し、従って、矢印④、⑤に示す如く外気がミッション3側の空気吸入口12を介して、ハウジングカバー26の中央部に備えた空気吸入口40…へ入り、その空気が矢印⑥に示す如くステータ24側の空気通路53…を通り、さらに、ロータ22側の空気通路33…を通してハウジング本体21側の空気排出口19…から外へ出る。従って、ステータ24及びロータ22を強制空気冷却することができる。

【0014】以上はステータをロータが囲うところのアウトロータ型発電電動機であったが、次にロータをステータが囲うところのインナーロータ型発電電動機を説明する。図6は本発明に係る発電電動機の別実施例図である。発電電動機2は、空気排出口19…を備えるモータハウジング20とカップ形のインナーロータ23と、このインナーロータ23の外部に同心的に収納したステータ24と、このステータ24を固定する軸受25を含むハウジングカバー26と、ベアリング27とからなる。

なお、モータハウジング20はハウジング本体21と、ハウジングカバー26からなる。インナーロータ23は内周面に所定数のマグネット29…と、内外を貫通する複数の空気通路33…と、これら空気通路33…の出口側に複数のガイド片34…とを備える。28はインナーロータ23の軸部材である。ステータ24は複数の積層板で構成した鉄心37…と、この鉄心37…に巻いたコイル38…と、これらを前記ハウジングカバー26に取付けるためのボルト39…とからなる。なお、モータハウジング20はハウジング本体21と、ハウジングカバー26からなる。すなわち、本例図は(インナー)ロータ23をステータ24に対し内側に配置した構造のところのインナーロータ型発電電動機である。

【0015】図7は図3の変形例図である。積層板35aはボルト穴42と、コイル巻線部43とを備えた「切欠き溝のない板」である。積層板35bはボルト穴42と、コイル巻線部43と、このコイル巻線部43中央から上方向へ向うU字切欠き溝44とを備えた「切欠き溝のある板」である。積層板35cはボルト穴42と、コイル巻線部43と、このコイル巻線部43中央から下方向へ向うU字切欠き溝49と、このU字切欠き溝49の右端にカット部50とを備えた「切欠き溝のある板」である。

【0016】図8は本発明に係る図7に示した積層板の変形例にて構成した発電電動機の断面図である。発電電動機2は、空気排出口19…を備えるモータハウジング20とカップ形のロータ22と、このロータ22の内部に同心的に収納したステータ24と、このステータ24を固定するハウジングカバー26とからなる。なお、モータハウジング20はハウジング本体21と、ハウジングカバー26からなる。ロータ22は内周面に所定数のマグネット29…と、内外を貫通する複数の空気通路33…と、これら空気通路33…の出口側に複数のガイド片34…とを備える。28はロータ22の軸部材である。ステータ24は複数の積層板35a…、35b…、35c…で構成した鉄心37…と、この鉄心37…に巻いたコイル38…と、これらを前記ハウジングカバー26に取付けるためのボルト39…とからなる。また、ハウジングカバー26は中央部に空気吸入口40…を備え、前記ハウジング本体21に固定される。本変形例はボルト穴42と、U溝44、49にて形成する空気通路54…とを別個備えた例を示し、積層板35a…、35b…、35c…にて構成した空気通路54…は、この空気通路54…の空気流入口54a…に幅広の開口部を備え、ボルト穴42と、U溝44、49にて形成する空気通路54…とを別個備えた例を示す。

【0017】なお、本発明の実施の形態において、ハイブリッド車駆動系装置内の発電電動機として示したが、本発明は上記発電電動機に限るものではなく、モータ及び発電機等全般にわたり、使用できる技術である。例え

ば、ファンを使用した空冷構造のもの、水冷構造あるいは油冷構造のものとの併用も可能である。また、図1の本発明に係るハイブリッド車駆動系装置の要部断面図に示したところのアウトロータ型、あるいは、図6の本発明に係る発電電動機の別実施例図に示したところのインナーロータ型にも使用できる。

#### 【0018】

【発明の効果】本発明は上記構成により次の効果を発揮する。請求項1は、モータハウジングに空気吸入口と空気排出口とを設け、モータハウジングに収納したステータ及びロータにモータの回転中心から径外方へ向う空気通路を開けた。従って、ステータ及びロータに空気を通し直接冷却することができ、特に発熱源であるステータのコイル鉄心内部の冷却ができる。また、ロータの回転数が上がると空気通路に流入する空気の量も増加し、冷却効果が大きくなるため、冷却能力が向上する。

【0019】請求項2は、モータハウジングに空気吸入口と空気排出口とを設け、モータハウジングにロータを収納し、このロータ内側にステータを収納し、これらステータ及びロータにモータの回転中心から径外方へ向う空気通路を開けた。従って、ステータ及びロータに空気を通し直接冷却することができ、特に発熱源であるステータのコイル鉄心内部の冷却ができる。また、ロータの回転数が上がると空気通路に流入する空気の量も増加し、冷却効果が大きくなるため、冷却能力が向上する。さらに、ステータに対しロータを外周に設けたので、遠心力が大きく、空気通路に流入する空気の量も多くできるのでさらに冷却効果が高い。

【0020】請求項3は、ステータのコイル鉄心を複数枚の積層板で構成し、切欠き溝のある鋼板と切欠き溝のない鋼板とを適宜組み合わせ積層することでステータの空気通路を形成した。従って、ステータのコイル鉄心を複数枚の積層板で構成し、切欠き溝のある鋼板と切欠き溝のない鋼板とを適宜組み合わせ積層することでステータの空気通路を形成したので、組み合わせ枚数により通路面積を変えることができる。また、別部品を使用することなく空気通路を形成できるので、安価である。

#### 【図面の簡単な説明】

【図1】本発明に係るハイブリッド車駆動系装置の要部断面図

【図2】図1の2-2線部分断面図

【図3】本発明に係る積層板の形状及び組立要領を示す図

【図4】本発明に係る積層板の組立図

【図5】本発明に係る電動機の冷却構造の作用説明図

【図6】本発明に係る発電電動機の別実施例図

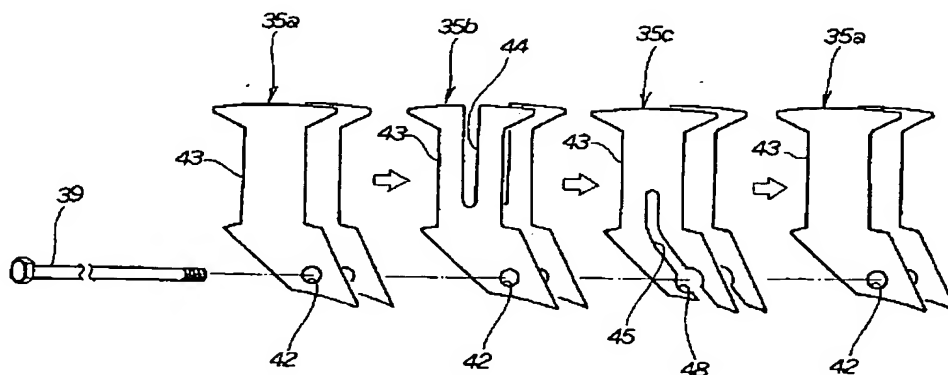
【図7】図3の変形例図

【図8】本発明に係る図7に示した積層板の変形例にて構成した発電電動機の断面図

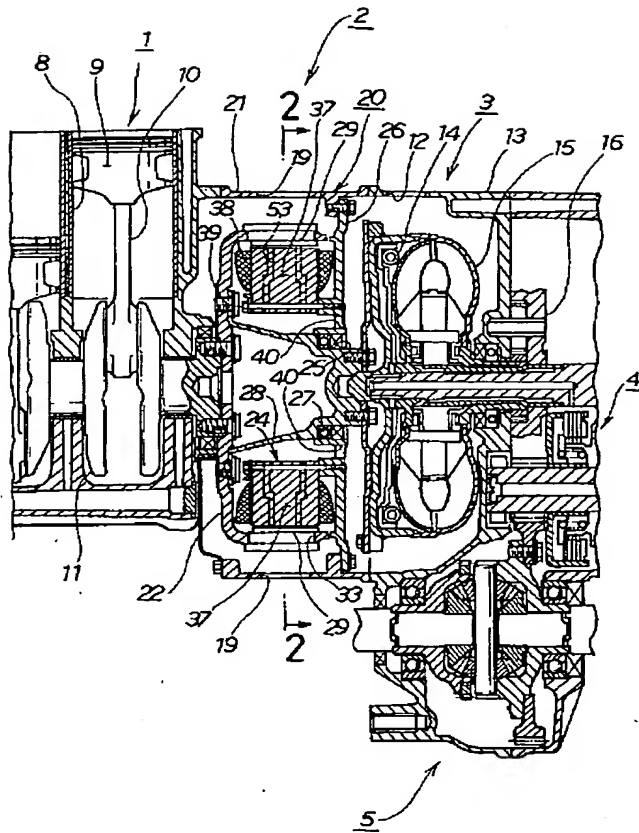
#### 【符号の説明】

2…発電電動機、12、40…空気吸入口、19…空気排出口、20…モータハウジング、22…ロータ、24…ステータ、33、53、54…空気通路、35a、35b、35c…積層板、37…鉄心、38…コイル、44、49…U字切欠き溝、45…略U字切欠き溝、48…丸部。

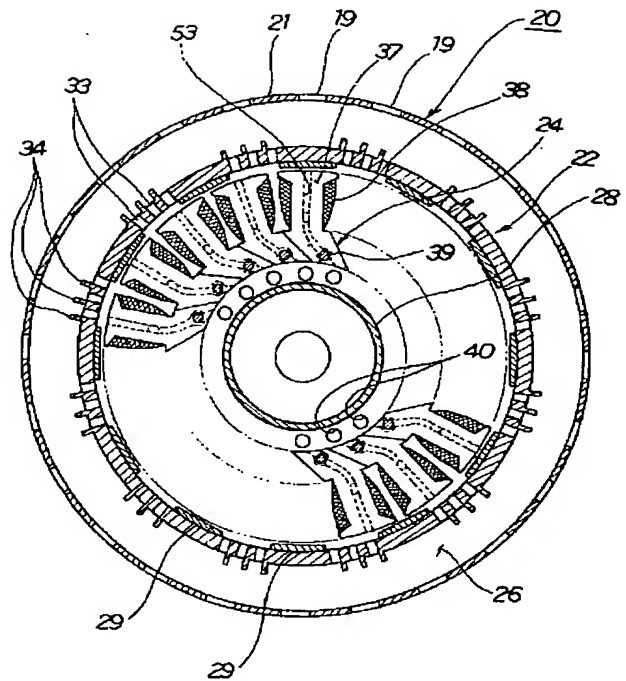
【図3】



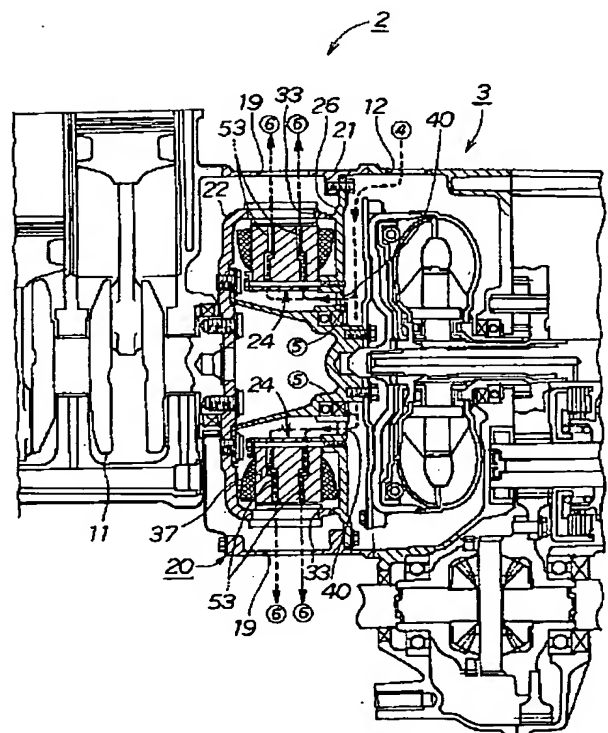
【図1】



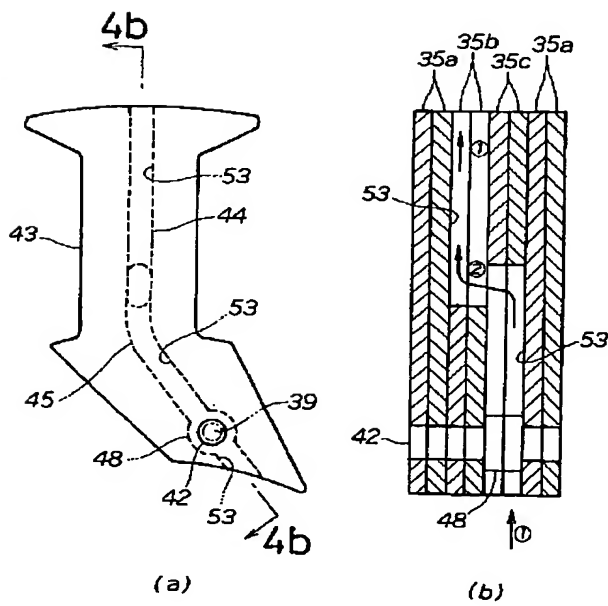
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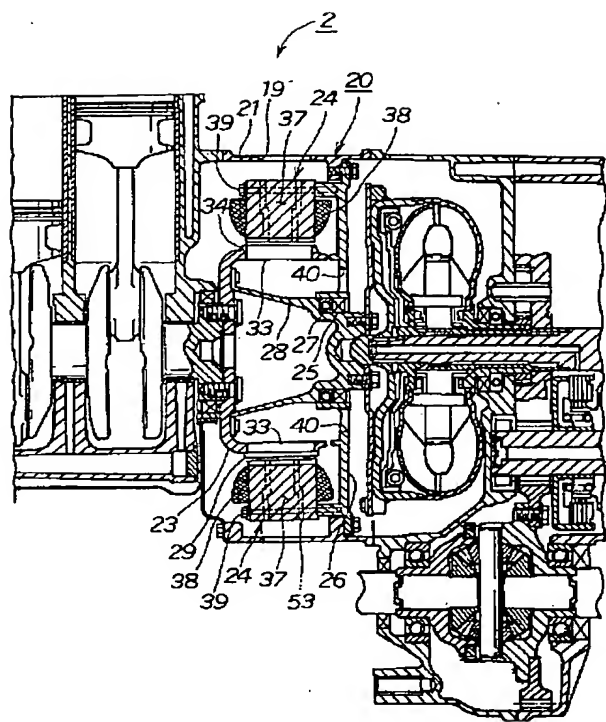
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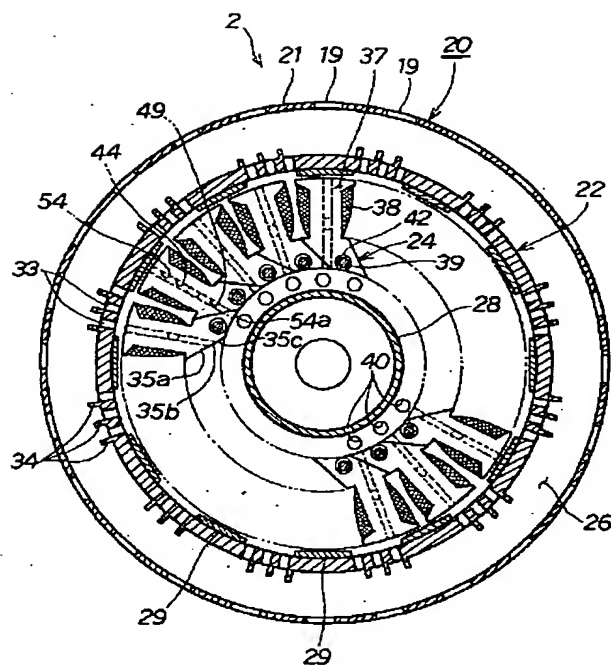
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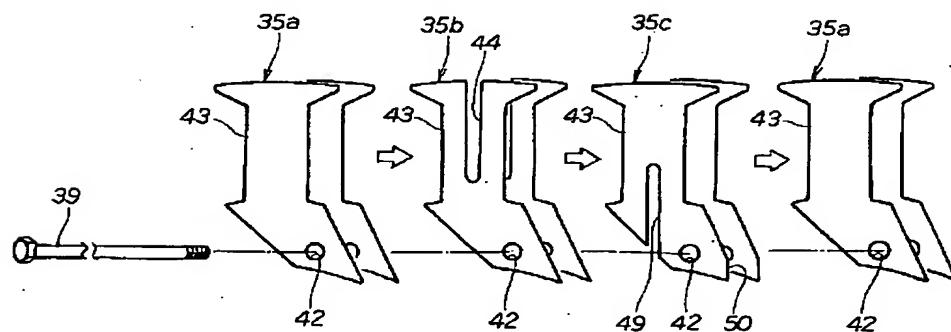
【図6】



【図8】



【図7】





# PATENT ABSTRACTS OF JAPAN

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H02K 9/02

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H02K 5/20

(21)Application number : 08-017720

(71)Applicant : HONDA MOTOR CO LTD

(22)Date of filing : 02.02.1996

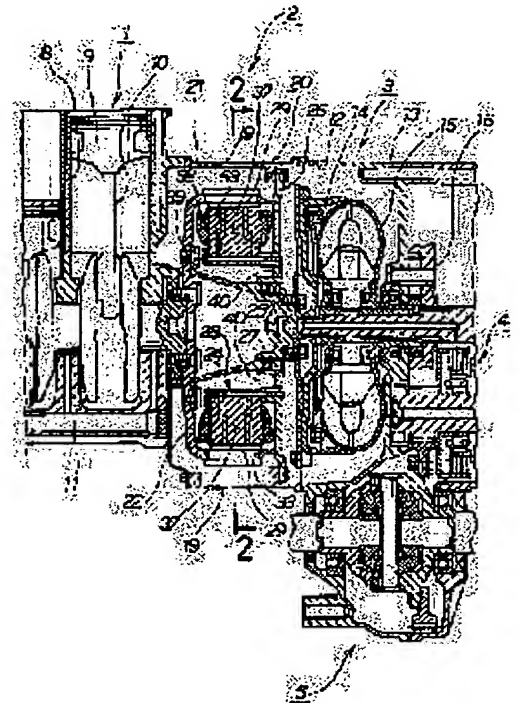
(72)Inventor : MASUI RITSUO

## (54) COOLING CONSTRUCTION FOR MOTOR

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To efficiently cool a stator and a rotor by providing an air inlet and an air outlet in a motor housing and opening air passages from the center of rotation to radial direction of the motor for the stator and rotor housed in the motor housing.

**SOLUTION:** A generator-motor 2 comprises a motor housing 20 equipped with air outlets 19... (... means plurality), a cup type rotor 22, a stator 22, a housing cover 26 and a bearing 27. The rotor 22 is equipped with a predetermined number of magnets 29... on the internal peripheral surface and a plurality of air passages 33... penetrating between the inside and the outside. Also, the housing cover 26 is equipped with air inlets 40... in the central portion. Then, the rotor 22 begins to rotate together with a crank shaft 11, outside air enters into the air inlets 40... through an air inlet 12 at the side of mission 3, and this air passes through air passages 33... from air passages 53... at the side of stator 24 and moves to outside from the air outlets 19 at the side of a housing main body 21. By doing this, forced air cooling becomes possible.



## LEGAL STATUS

[Date of request for examination] 15.10.1999

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[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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3. In the drawings, any words are not translated.

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CLAIMS

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[Claim(s)]

[Claim 1] Cooling structure of the motor characterized by opening the other air duct from the center of rotation of a motor to the method of the outside of a path in the stator and Rota which prepared the air-suction-system mouth and the air exhaust port in motor housing, and were contained in motor housing.

[Claim 2] Cooling structure of the motor characterized by having prepared the air-suction-system mouth and the air exhaust port in motor housing, having contained Rota in motor housing, having contained the stator to this Rota inside, and opening the other air duct in these stators and Rota from the center of rotation of a motor to the method of the outside of a path.

[Claim 3] Cooling structure of the motor according to claim 1 or 2 characterized by forming the air duct of a stator by carrying out the combination laminating of the being [ a steel plate which constitutes the coil iron core of the aforementioned stator from a laminate of two or more sheets, and has a notch slot, and a notch slot ] steel plate suitably.

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[Translation done.]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the improvement technology of the cooling structure of a motor.

[0002]

[Description of the Prior Art] In order for a motor to contain a stator in motor housing at the Rota row, to pass current and to rotate Rota, the Joule's heat occurs inevitably on the structure, and it needs to miss this Joule's heat suitably. it considers as the technology, for example, JP,4-317542,A "braking of vehicles and the cooling system of the induction machine for auxiliary driving gears" is known According to drawing 1 of this official report, this technology is the oil-injection-type structure of containing an induction machine 2 in housing 32 and 64, supplying oil to these housing 32 and 64, and absorbing generation of heat of an induction machine 2 in this oil.

[0003]

[Problem(s) to be Solved by the Invention] In the above-mentioned oil injection type, part mark, such as a refrigerant path, seal parts, a circulating pump, and a radiator, were also mostly complicated, and it was expensive also in cost. Although the air cooling structure which cools motor housing by the fan every outside is generally adopted, although motor housing is cooled, since, as for a stator, the edge has run out in the Rota row of the interior, by this method, it is hard to be cooled on the other hand. Moreover, it was also the cause by which a stator maintains a fixed slit, and was supported by these Rota row, the coil front face wound around this stator had usually fixed with the resin or the varnish for the cure against waterproofing, or coil coil maintenance, and this barred the thermolysis effect.

[0004] Then, the purpose of this invention is to offer the cooling structure of the motor which can cool a stator and Rota effectively.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, a claim 1 prepares an air-suction-system mouth and an air exhaust port in motor housing, and is characterized by opening the other air duct from the center of rotation of a motor to the method of the outside of a path in the stator and Rota which were contained in motor housing. Air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves.

[0006] A claim 2 prepares an air-suction-system mouth and an air exhaust port in motor housing, contains Rota in motor housing, contains a stator to this Rota inside, and is characterized by opening the other air duct in these stators and Rota from the center of rotation of a motor to the method of the outside of a path. Air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves. Since Rota was established in the periphery to the stator, a centrifugal force is large, and since the amount of the air which flows into an air duct can also be made [ many ], the cooling effect is still higher.

[0007] A claim 3 constitutes the coil iron core of a stator from a laminate of two or more sheets, and is characterized by forming the air duct of a stator by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably. The coil iron core of a stator is constituted from a laminate of two or more sheets, and since the air duct of a stator was formed by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably, path area is changeable with combination number of sheets. Since an air duct can be formed without using another parts, it is cheap.

[0008]

[Embodiments of the Invention] The gestalt of operation of this invention is explained below based on an attached drawing. In addition, a drawing shall be seen to the sense of a sign. Drawing 1 is the important section cross section of the hybrid car drive-system equipment concerning this invention. Hybrid car drive-system equipment consists of an engine 1, a generator motor 2, missions 3, a clutch 4, and a differential gear 5. The aforementioned engine 1 is equipped with a cylinder 8, a piston 9, a connecting rod 10, and a crankshaft 11. Missions 3 consist of the missions housing 13 equipped with the air-suction-system mouth 12, a torque converter 15 equipped with the lock-up clutch 14, and an automatic transmission 16.

[0009] A generator motor 2 is the air exhaust port 19. -- (-- shows plurality.) the following -- being the same -- it consists of housing covering 26 containing the bearing 25 which fixes the stator 24 contained in the said heart, and this stator 24 to the interior of the motor housing 20 which it has, Rota 22 of a cup form, and this Rota 22, and bearing 27 In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26.

[0010] Drawing 2 is a cross section by two to 2 line part of drawing 1, and Rota 22 equips inner skin with piece of guide 34 [ of magnet 29 -- of a predetermined number, two or more air duct 33-- which penetrates inside and outside, and these air duct 33-- ] of plurality [ outlet side ] --. 28 is the shank material of Rota 22. A stator 24 consists of iron core 37 -- constituted from two or more laminates (detailed after-mentioned), coil 38-- wound around this iron core 37 --, and bolt 39-- for attaching these in the aforementioned housing covering 26. Moreover, the housing covering 26 equips a center section with air-suction-system mouth 40 --, and is fixed to the aforementioned housing main part 21.

[0011] Drawing 3 is drawing showing the configuration and the assembly point of a laminate concerning this invention. Laminate 35a is "a board without a notch slot" equipped with a bolthole 42 and the coil coil section 43. Laminate 35b is a bolthole 42, the coil coil section 43, and "the board with a notch slot" equipped with the other notch slot 44 of U characters from this coil coil section 43 center to above. Laminate 35c is the coil coil section 43 and "the board with a notch slot" which was equipped with the other abbreviation notch slot 45 for U characters from this coil coil section 43 center to slanting down one, and equipped further this abbreviation notch slot 45 for U characters with \*\*\*\* 48 for bolt penetration of a major diameter from the aforementioned bolthole 42.

[0012] Drawing 4 (a) - (b) is the assembly drawing of the laminate concerning this invention. (a) is the front view after the assembly of Laminates 35a-35c, and a dashed line shows formed air duct 53 --. In addition, like the above-mentioned, from the aforementioned bolthole 42, since \*\*\*\* 48 for bolt penetration is a major diameter further, even if it lets a bolt 39 pass, there is nothing of laminate 35c-- for which air duct 53 -- is closed. (b) shows two 4b-4b line cross sections after assembly at a time for laminate 35a--, 35b--, 35c--, and 35a--, respectively. Arrow \*\*, \*\*, and \*\* show the flow of the air which passes along formed air duct 53 --.

[0013] An operation of the cooling structure of the motor stated above is explained below. Drawing 5 is operation explanatory drawing of the cooling structure of the motor concerning this invention. If a crankshaft 11 rotates, Rota 22 will begin to rotate with this crankshaft 11. This Rota 22 goes into air-suction-system mouth 40 -- with which the open air equipped the center section of the housing covering 26 through the air-suction-system mouth 12 by the side of missions 3, as a fan's configuration is presented as shown in drawing 2, therefore shown in arrow \*\* and \*\*, as the air shows arrow \*\*, it passes along air duct 53 -- by the side of a stator 24, and it comes out of it outside through air duct 33 -- of Rota 22 further from air exhaust port 19 -- by the side of the housing main part 21. Therefore, the forcible air-cooling of a stator 24 and Rota 22 can be carried out.

[0014] Although the above was an outer-rotor type generator motor to which Rota encloses a stator, the inner rotor type generator motor to which a stator next encloses Rota is explained. Drawing 6 is another example view of the generator motor concerning this invention. A generator motor 2 consists of housing covering 26 containing the bearing 25 which fixes to the exterior of the motor housing 20 and the inner rotor 23 of a cup form equipped with air exhaust port 19 --, and this inner rotor 23 the stator 24 contained in the said heart, and this stator 24, and bearing 27. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26. The inner rotor 23 equips inner skin with piece of guide 34 [ of magnet 29 -- of a predetermined number, two or more air duct 33-- which penetrates inside and outside, and these air duct 33-- ] of plurality [ outlet side ] --. 28 is the shank material of the inner rotor 23. A stator 24 consists of iron core 37 -- constituted from two or more laminates, coil 38-- wound around this iron core 37 --, and bolt 39-- for attaching these in the aforementioned housing covering 26. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26. That is, this example view is the inner rotor type generator motor of the place of the structure which has arranged Rota (inner) 23 inside to a stator 24.

[0015] Drawing 7 is the modification view of drawing 3. Laminate 35a is "a board without a notch slot" equipped with a bolthole 42 and the coil coil section 43. Laminate 35b is a bolthole 42, the coil coil section 43, and "the board with a notch slot" equipped with the other notch slot 44 of U characters from this coil coil section 43 center to above. Laminate 35c is a bolthole 42, the coil coil section 43, and "the board with a notch slot" that equipped the right end of the other

notch slot 49 of U characters, and this U character notch slot 49 with the cut section 50 from this coil coil section 43 center to down.

[0016] Drawing 8 is the cross section of the generator motor constituted from a modification of a laminate shown in drawing 7 concerning this invention. A generator motor 2 consists of housing covering 26 which fixes to the interior of the motor housing 20 equipped with air exhaust port 19 --, Rota 22 of a cup form, and this Rota 22 the stator 24 contained in the said heart, and this stator 24. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26. Rota 22 equips inner skin with piece of guide 34 [ of magnet 29 -- of a predetermined number, two or more air duct 33-- which penetrates inside and outside, and these air duct 33-- ] of plurality [ outlet side ] --. 28 is the shank material of Rota 22. A stator 24 consists of two or more laminate 35a--, 35b--, iron core 37-- constituted from 35c-- and coil 38-- wound around this iron core 37 --, and bolt 39-- for attaching these in the aforementioned housing covering 26. Moreover, the housing covering 26 equips a center section with air-suction-system mouth 40 --, and is fixed to the aforementioned housing main part 21. This modification shows the example separately equipped with a bolthole 42 and air duct 54 -- formed in the U slots 44 and 49, and shows the example separately equipped with laminate 35a--, and a bolthole 42 and air duct 54 -- formed in the U slots 44 and 49 by equipping with opening with this air duct 54 -- broad to airstream entrance 54a-- 35b-- and air duct 54-- constituted from 35c--.

[0017] In addition, in the gestalt of operation of this invention, although shown as a generator motor in hybrid car drive-system equipment, this invention is the technology which does not restrict to the above-mentioned generator motor, crosses to a motor, a generator at large, etc., and can be used. For example, the combined use with the thing of the thing of the air-cooling structure which used the fan, water-cooled structure, or oil-quenching structure is also possible. Moreover, it can be used also for the outer-rotor type shown in the important section cross section of the hybrid car drive-system equipment concerning this invention of drawing 1 , or the inner rotor type shown in another example view of the generator motor concerning this invention of drawing 6 .

[0018]

[Effect of the Invention] this invention demonstrates the following effect by the above-mentioned composition. The claim 1 prepared the air-suction-system mouth and the air exhaust port in motor housing, and the other air duct was opened in the stator and Rota which were contained in motor housing from the center of rotation of a motor to the method of the outside of a path. Therefore, air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Moreover, since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves.

[0019] The claim 2 prepared the air-suction-system mouth and the air exhaust port in motor housing, contained Rota in motor housing, contained the stator to this Rota inside, and opened the other air duct in these stators and Rota from the center of rotation of a motor to the method of the outside of a path. Therefore, air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Moreover, since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves. Furthermore, since Rota was established in the periphery to the stator, a centrifugal force is large, and since the amount of the air which flows into an air duct can also be made [ many ], the cooling effect is still higher.

[0020] The claim 3 constituted the coil iron core of a stator from a laminate of two or more sheets, and the air duct of a stator was formed by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably. Therefore, since the air duct of a stator was formed by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably, path area is changeable [ the coil iron core of a stator is constituted from a laminate of two or more sheets, and ] with combination number of sheets. Moreover, since an air duct can be formed without using another parts, it is cheap.

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[Translation done.]

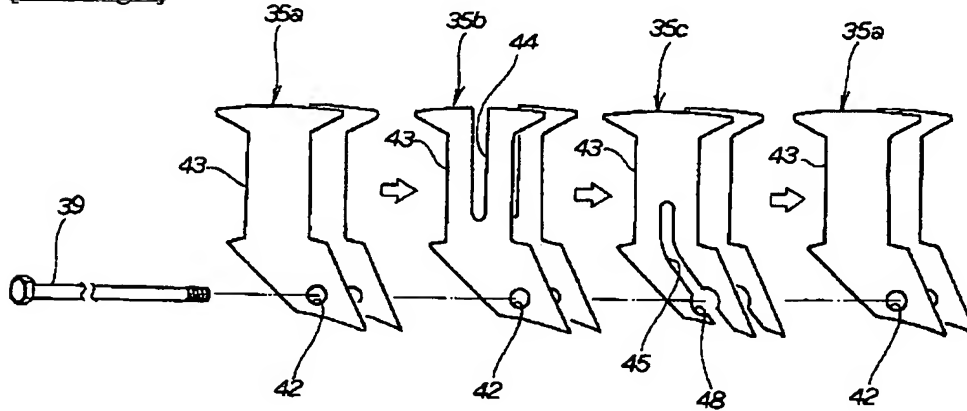
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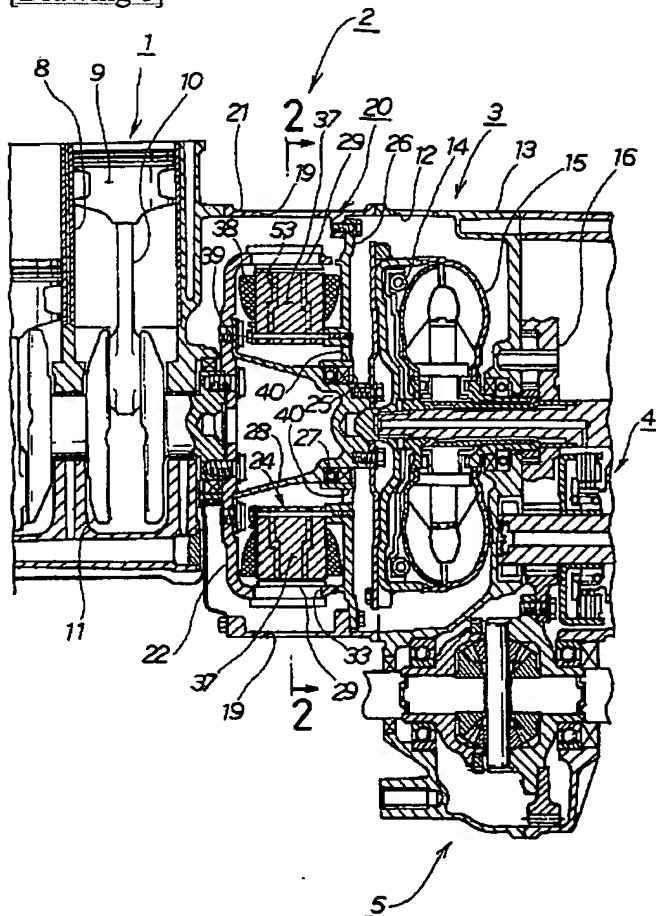
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## DRAWINGS

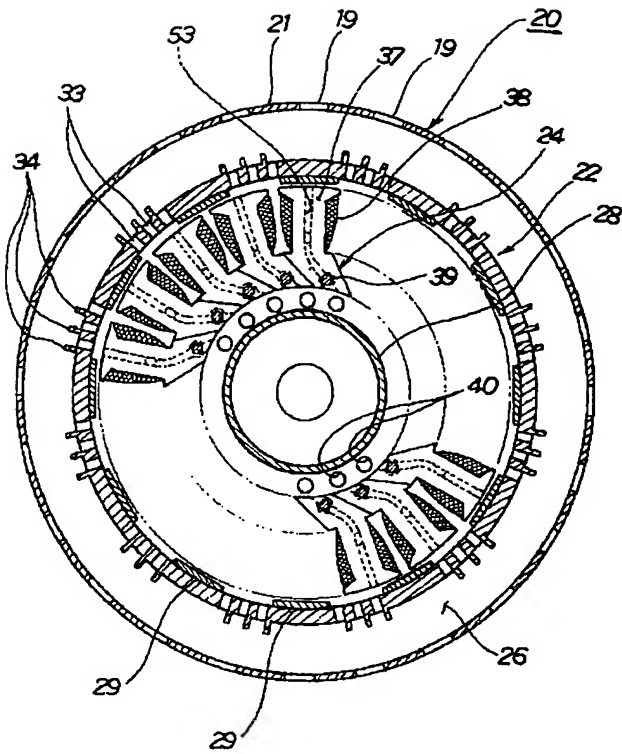
[Drawing 3]



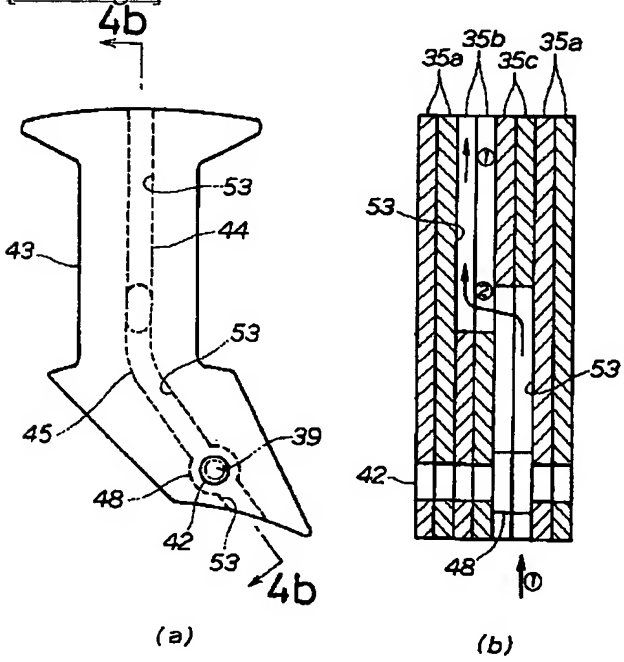
[Drawing 1]



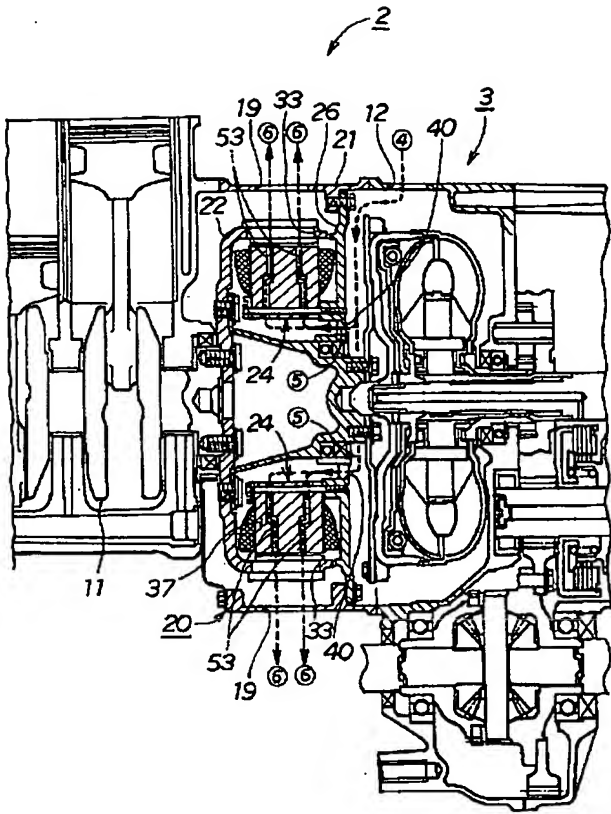
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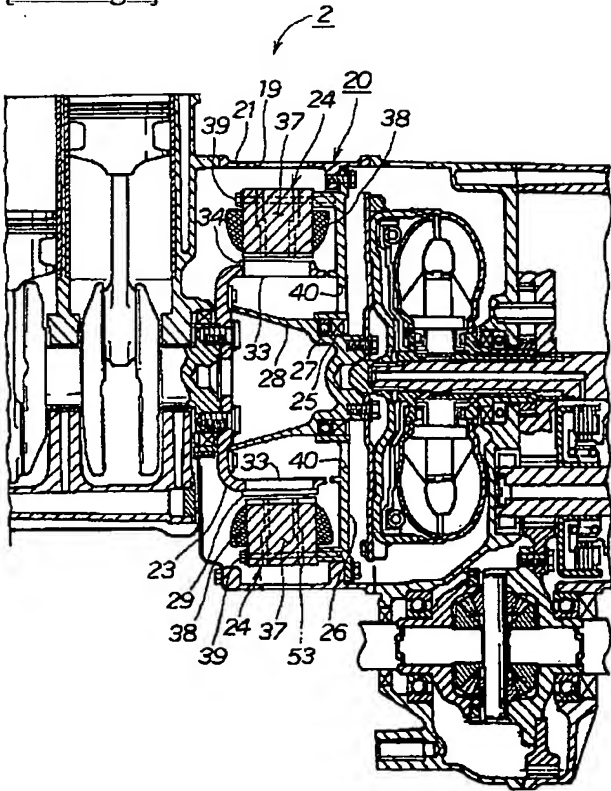
[Drawing 4]



[Drawing 5]

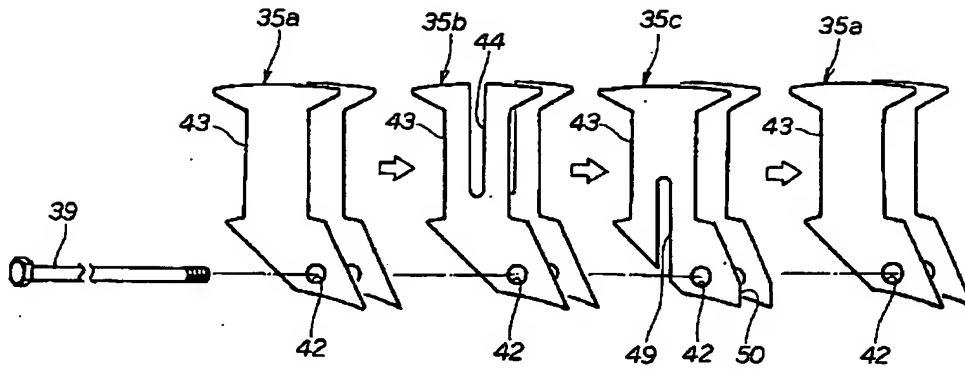


[Drawing 6]

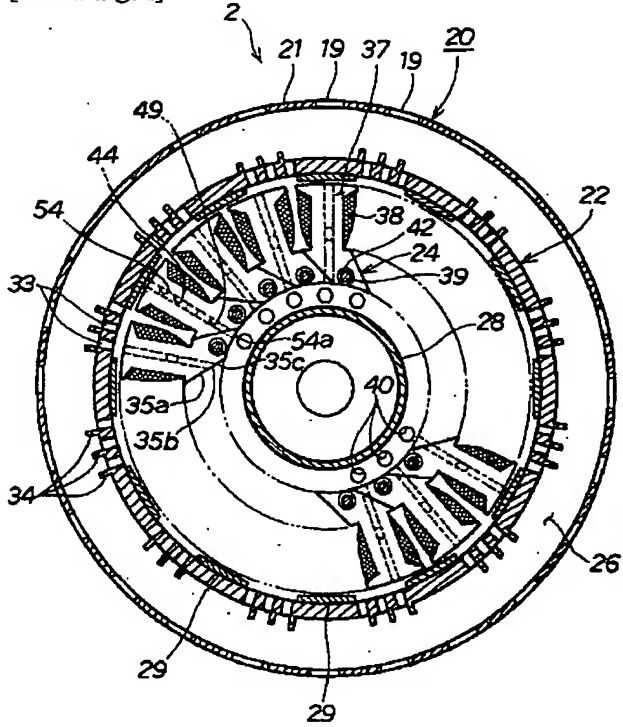


[Drawing 7]





[Drawing 8]



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**CORRECTION or AMENDMENT**


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[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law  
 [Section partition] The 4th partition of the 7th section  
 [Date of issue] October 5, Heisei 13 (2001. 10.5)

[Publication No.] JP,9-215270,A  
 [Date of Publication] August 15, Heisei 9 (1997. 8.15)  
 [\*\*\*\* format] Open patent official report 9-2153  
 [Filing Number] Japanese Patent Application No. 8-17720  
 [The 7th edition of International Patent Classification]

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 5/20

[FI]

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 1/20 D  
 1/32 C  
 5/20

[Procedure revision]  
 [Filing Date] November 21, Heisei 12 (2000. 11.21)  
 [Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] Whole sentence

[Method of Amendment] Change

[Proposed Amendment]

[Document Name] Specification

[Title of the Invention] Cooling structure of a motor

[Claim(s)]

[Claim 1] Cooling structure of the motor characterized by opening the other air duct from the center of rotation of a motor to the method of the outside of a path in the stator and Rota which prepared the air-suction-system mouth and the air exhaust port in motor housing, and were contained in motor housing.

[Claim 2] Cooling structure of the motor characterized by having prepared the air-suction-system mouth and the air exhaust port in motor housing, having contained Rota in motor housing, having contained the stator to this Rota inside, and opening the other air duct in these stators and Rota from the center of rotation of a motor to the method of the outside of a path.

[Claim 3] Cooling structure of the motor according to claim 1 or 2 characterized by forming the air duct of a stator by carrying out the combination laminating of the being [ a steel plate which constitutes the coil iron core of the aforementioned stator from a laminate of two or more sheets, and has a notch slot, and a notch slot ] steel plate suitably.

[Claim 4] Cooling structure of the motor according to claim 1 or 2 characterized by preparing the piece of a guide which shows an airstream to the outlet side of the aforementioned air duct.

## [Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the improvement technology of the cooling structure of a motor.

[0002]

[Description of the Prior Art] In order for a motor to contain a stator in motor housing at the Rota row, to pass current and to rotate Rota, the Joule's heat occurs inevitably on the structure, and it needs to miss this Joule's heat suitably. it considers as the technology, for example, JP,4-317542,A "braking of vehicles and the cooling system of the induction machine for auxiliary driving gears" is known According to drawing 1 of this official report, this technology is the oil-injection-type structure of containing an induction machine 2 in housing 32 and 64, supplying oil to these housing 32 and 64, and absorbing generation of heat of an induction machine 2 in this oil.

[0003]

[Problem(s) to be Solved by the Invention] In the above-mentioned oil injection type, part mark, such as a refrigerant path, seal parts, a circulating pump, and a radiator, were also mostly complicated, and it was expensive also in cost. Although the air cooling structure which cools motor housing by the fan every outside is generally adopted, although motor housing is cooled, since, as for a stator, the edge has run out in the Rota row of the interior, by this method, it is hard to be cooled on the other hand. Moreover, it was also the cause by which a stator maintains a fixed slit, and was supported by these Rota row, the coil front face wound around this stator had usually fixed with the resin or the varnish for the cure against waterproofing, or coil coil maintenance, and this barred the heat dissipation effect.

[0004] Then, the purpose of this invention is to offer the cooling structure of the motor which can cool a stator and Rota effectively.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, a claim 1 prepares an air-suction-system mouth and an air exhaust port in motor housing, and is characterized by opening the other air duct from the center of rotation of a motor to the method of the outside of a path in the stator and Rota which were contained in motor housing. Air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves.

[0006] A claim 2 prepares an air-suction-system mouth and an air exhaust port in motor housing, contains Rota in motor housing, contains a stator to this Rota inside, and is characterized by opening the other air duct in these stators and Rota from the center of rotation of a motor to the method of the outside of a path. Air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves. Since Rota was established in the periphery to the stator, a centrifugal force is large, and since the amount of the air which flows into an air duct can also be made [ many ], the cooling effect is still higher.

[0007] A claim 3 constitutes the coil iron core of a stator from a laminate of two or more sheets, and is characterized by forming the air duct of a stator by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably. The coil iron core of a stator is constituted from a laminate of two or more sheets, and since the air duct of a stator was formed by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably, path area is changeable with combination number of sheets. Since an air duct can be formed without using another parts, it is cheap.

[0008] A claim 4 is characterized by preparing the piece of a guide which shows an airstream to the outlet side of an air duct. By preparing the piece of a guide which shows an airstream to the outlet side of an air duct, the piece of a guide is made to serve as a fan function, and promotion of compulsive air quenching is aimed at for stator \*\* Rota.

[0009]

[Embodiments of the Invention] The form of operation of this invention is explained below based on an attached drawing. In addition, a drawing shall be seen to the sense of a sign. Drawing 1 is the important section cross section of the hybrid car drive-system equipment concerning this invention. Hybrid car drive-system equipment consists of an engine 1, a generator motor 2, missions 3, a clutch 4, and a differential gear 5. The aforementioned engine 1 is equipped with a cylinder 8, a piston 9, a connecting rod 10, and a crankshaft 11. Missions 3 consist of the missions housing 13 equipped with the air-suction-system mouth 12, a torque converter 15 equipped with the lock-up clutch 14, and an automatic transmission 16.

[0010] A generator motor 2 is the air exhaust port 19. -- (-- shows plurality.) the following -- being the same -- it

consists of housing covering 26 containing the bearing 25 which fixes the stator 24 contained in the said heart, and this stator 24 to the interior of the motor housing 20 which it has, Rota 22 of a cup form, and this Rota 22, and bearing 27. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26.

[0011] Drawing 2 is a cross section by two to 2 line part of drawing 1, and Rota 22 equips inner skin with piece of guide 34 [ of magnet 29 -- of a predetermined number, two or more air duct 33-- which penetrates inside and outside, and these air duct 33-- ] of plurality [ outlet side ] --. 28 is the shank material of Rota 22. A stator 24 consists of iron core 37 -- constituted from two or more laminates (detailed after-mentioned), coil 38-- wound around this iron core 37 --, and bolt 39-- for attaching these in the aforementioned housing covering 26. Moreover, the housing covering 26 equips a center section with air-suction-system mouth 40 --, and is fixed to the aforementioned housing main part 21.

[0012] Drawing 3 is drawing showing the configuration and the assembly point of a laminate concerning this invention. Laminate 35a is "a board without a notch slot" equipped with a bolthole 42 and the coil coil section 43. Laminate 35b is a bolthole 42, the coil coil section 43, and "the board with a notch slot" equipped with the other notch slot 44 of U characters from this coil coil section 43 center to above. Laminate 35c is the coil coil section 43 and "the board with a notch slot" which was equipped with the other abbreviation notch slot 45 for U characters from this coil coil section 43 center to slanting down one, and equipped further this abbreviation notch slot 45 for U characters with \*\*\*\* 48 for bolt penetration of a major diameter from the aforementioned bolthole 42.

[0013] Drawing 4 (a) - (b) is the assembly drawing of the laminate concerning this invention.

(a) is the front view after the assembly of Laminates 35a-35c, and a dashed line shows formed air duct 53 --. In addition, like the above-mentioned, from the aforementioned bolthole 42, since \*\*\*\* 48 for bolt penetration is a major diameter further, even if it lets a bolt 39 pass, there is nothing of laminate 35c-- for which air duct 53 -- is closed.

(b) shows two 4b-4b line cross sections after assembly at a time for laminate 35a--, 35b--, 35c--, and 35a--, respectively. Arrow \*\*, \*\*, and \*\* show the flow of the air which passes along formed air duct 53 --.

[0014] An operation of the cooling structure of the motor stated above is explained below. Drawing 5 is operation explanatory drawing of the cooling structure of the motor concerning this invention. If a crankshaft 11 rotates, Rota 22 will begin to rotate with this crankshaft 11. This Rota 22 goes into air-suction-system mouth 40 -- with which the open air equipped the center section of the housing covering 26 through the air-suction-system mouth 12 by the side of missions 3, as a fan's configuration is presented as shown in drawing 2, therefore shown in arrow \*\* and \*\*, as the air shows arrow \*\*, it passes along air duct 53 -- by the side of a stator 24, and it comes out of it outside through air duct 33 -- of Rota 22 further from air exhaust port 19 -- by the side of the housing main part 21. Therefore, the forcible air-cooling of a stator 24 and Rota 22 can be carried out.

[0015] Although the above was an outer-rotor type generator motor to which Rota encloses a stator, the inner rotor type generator motor to which a stator next encloses Rota is explained. Drawing 6 is another example view of the generator motor concerning this invention. A generator motor 2 consists of housing covering 26 containing the bearing 25 which fixes to the exterior of the motor housing 20 and the inner rotor 23 of a cup form equipped with air exhaust port 19 --, and this inner rotor 23 the stator 24 contained in the said heart, and this stator 24, and bearing 27. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26. The inner rotor 23 equips inner skin with piece of guide 34 [ of magnet 29 -- of a predetermined number, two or more air duct 33-- which penetrates inside and outside, and these air duct 33-- ] of plurality [ outlet side ] --. 28 is the shank material of the inner rotor 23. A stator 24 consists of iron core 37 -- constituted from two or more laminates, coil 38-- wound around this iron core 37 --, and bolt 39-- for attaching these in the aforementioned housing covering 26. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26. That is, this example view is the inner rotor type generator motor of the place of the structure which has arranged Rota (inner) 23 inside to a stator 24.

[0016] Drawing 7 is the modification view of drawing 3. Laminate 35a is "a board without a notch slot" equipped with a bolthole 42 and the coil coil section 43. Laminate 35b is a bolthole 42, the coil coil section 43, and "the board with a notch slot" equipped with the other notch slot 44 of U characters from this coil coil section 43 center to above. Laminate 35c is a bolthole 42, the coil coil section 43, and "the board with a notch slot" that equipped the right end of the other notch slot 49 of U characters, and this U character notch slot 49 with the cut section 50 from this coil coil section 43 center to down.

[0017] Drawing 8 is the cross section of the generator motor constituted from a modification of a laminate shown in drawing 7 concerning this invention. A generator motor 2 consists of housing covering 26 which fixes to the interior of the motor housing 20 equipped with air exhaust port 19 --, Rota 22 of a cup form, and this Rota 22 the stator 24 contained in the said heart, and this stator 24. In addition, the motor housing 20 serves as the housing main part 21 from the housing covering 26. Rota 22 equips inner skin with piece of guide 34 [ of magnet 29 -- of a predetermined number, two or more air duct 33-- which penetrates inside and outside, and these air duct 33-- ] of plurality [ outlet side ] --. 28 is the shank material of Rota 22. A stator 24 consists of two or more laminate 35a--, 35b--, iron core 37-- constituted from

35c-- and coil 38-- wound around this iron core 37 --, and bolt 39-- for attaching these in the aforementioned housing covering 26. Moreover, the housing covering 26 equips a center section with air-suction-system mouth 40 --, and is fixed to the aforementioned housing main part 21. This modification shows the example separately equipped with a bolthole 42 and air duct 54 -- formed in the U slots 44 and 49, and shows the example separately equipped with laminate 35a--, and a bolthole 42 and air duct 54 -- formed in the U slots 44 and 49 by equipping with opening with this air duct 54 -- broad to airstream entrance 54a-- 35b-- and air duct 54-- constituted from 35c--.

[0018] In addition, in the form of operation of this invention, although shown as a generator motor in hybrid car drive-system equipment, this invention is the technology which does not restrict to the above-mentioned generator motor, crosses to a motor, a generator at large, etc., and can be used. For example, the combined use with the thing of the thing of the air-cooling structure which used the fan, water-cooled structure, or oil-quenching structure is also possible. Moreover, it can be used also for the outer-rotor type shown in the important section cross section of the hybrid car drive-system equipment concerning this invention of drawing 1, or the inner rotor type shown in another example view of the generator motor concerning this invention of drawing 6.

[0019]

[Effect of the Invention] this invention demonstrates the following effect by the above-mentioned composition. The claim 1 prepared the air-suction-system mouth and the air exhaust port in motor housing, and the other air duct was opened in the stator and Rota which were contained in motor housing from the center of rotation of a motor to the method of the outside of a path. Therefore, air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Moreover, since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves.

[0020] The claim 2 prepared the air-suction-system mouth and the air exhaust port in motor housing, contained Rota in motor housing, contained the stator to this Rota inside, and opened the other air duct in these stators and Rota from the center of rotation of a motor to the method of the outside of a path. Therefore, air can be cooled directly [ through ] to a stator and Rota, and cooling inside the coil iron core of the stator which is especially a source of generation of heat can be performed. Moreover, since the amount of the air which flows into an air duct will also increase and the cooling effect will become large if the rotational frequency of Rota goes up, refrigeration capacity improves. Furthermore, since Rota was established in the periphery to the stator, a centrifugal force is large, and since the amount of the air which flows into an air duct can also be made [ many ], the cooling effect is still higher.

[0021] The claim 3 constituted the coil iron core of a stator from a laminate of two or more sheets, and the air duct of a stator was formed by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably. Therefore, since the air duct of a stator was formed by carrying out the combination laminating of the being [ a steel plate with a notch slot and a notch slot ] steel plate suitably, path area is changeable [ the coil iron core of a stator is constituted from a laminate of two or more sheets, and ] with combination number of sheets. Moreover, since an air duct can be formed without using another parts, it is cheap.

[0022] Since the claim 4 prepared the piece of a guide which shows an airstream to the outlet side of an air duct, it can make the piece of a guide serve as a fan function. Consequently, promotion of compulsive air quenching can be aimed at for stator \*\* Rota.

[Brief Description of the Drawings]

[Drawing 1] The important section cross section of the hybrid car drive-system equipment concerning this invention

[Drawing 2] It is a cross section by two to 2 line part of drawing 1.

[Drawing 3] Drawing showing the configuration and the assembly point of a laminate concerning this invention

[Drawing 4] Assembly drawing of the laminate concerning this invention

[Drawing 5] Operation explanatory drawing of the cooling structure of the motor concerning this invention

[Drawing 6] Another example view of the generator motor concerning this invention

[Drawing 7] The modification view of drawing 3

[Drawing 8] The cross section of the generator motor constituted from a modification of a laminate shown in drawing 7 concerning this invention

[Description of Notations]

2 [ -- An air exhaust port, 20 / -- Motor housing, 22 / -- Rota, 24 / -- A stator,, 33, 53, 54 / -- An air duct,, 35a 35b, 35c / -- A laminate, 37 / -- An iron core, 38 / -- A coil, 44, a 49--U character notch slot 45 / -- The abbreviation notch slot for U characters,, 48 / -- Round-head section. ] -- 12 A generator motor, 40 -- An air-suction-system mouth, 19